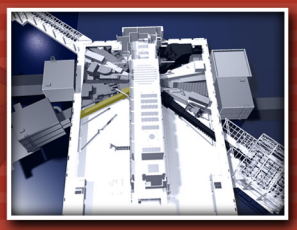
Instrument Fact Sheet

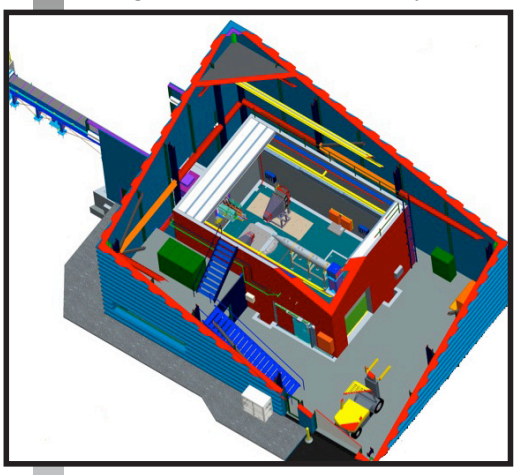
BEAM LINE 7

Spallation Neutron Source



Vulcan – Engineering Materials Diffractometer

VULCAN is designed to tackle a variety of problems in materials science and engineering. The instrument allows users to determine stress distribution in engineering components and to understand more about the deformation of materials under complex loading conditions. Through these measurements, VULCAN can help scientists and engineers test the reliability of structural components and better understand how materials deform. Characteristics of the instrument include stress mapping with a 1 mm^3 sampling volume and in situ loading with 10 to 20 reflections. Early commissioning results have shown that the flux on sample reaches 10^8 neutrons/cm^2/s. With such a high intensity, a diffraction pattern can be recorded within a second or less, enabling real-time studies of the phase transformation kinetics. The instrument team plans to install a small-angle detector in the near future. This will allow users to conduct simultaneous measurements of small-angle scattering, opening new research opportunities to study structure evolution at multiple length scales. Available sample environments and equipment include a unique load-frame capable of multi-axial loading and fatigue tests, a high-temperature vacuum furnace, a portable friction stir-welding machine, and standard equipment from the sample environment group.



Specifications

Sample-to-detector distance	~ 2 m
Detector angular coverage	$33.5^o < 2\theta < 56.5^o \pm 15^o$ out of horizontal plane
Wavelength bandwidth/ d-spacing band (Å)	~1.44 at 60 Hz d : 0.5-1.5 ~2.88 at 30 Hz d : 0.5-2.5
Resolution	~0.25% in high-resolution mode ~0.45% in high-intensity mode
Flux on sample (n/s/cm^2) at 60 Hz	2.2 x 10^7 in high-resolution mode 6.7 x 107 in high-intensity mode
Gauge volume (mm)	residual strain/phase mapping: 8–20 in situ loading and/ or heating: 100–250

Status: In commissioning

Applications

VULCAN covers a broad range of applications in materials science and engineering, from residual stress determination in engineering components to understanding the fundamental aspects of materials behaviors during processing and use. Although it is difficult to predict the kinds of new science that will be enabled by instruments like VULCAN, research areas that VULCAN could benefit include the following:

- In situ studies of materials behavior during processing: temperature distribution, texture changes, stress development, precipitation
- In situ loading studies at high or cryogenic temperatures: fatigue damage, deformation in nanostructured materials, creep behaviors, piezoelectric and shape-memory alloys
- Residual stress and microstructure changes in surface-engineered materials
- Deformation in amorphous materials
- Phase transformation kinetics

For more information, contact

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http://neutrons.ornl.gov/instruments/SNS/VULCAN

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